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**RESULTS OF THE JUNE 2014
LUMBER KILN TESTS CONDUCTED
FOR POTLATCH FOREST PRODUCTS CORPORATION
AT THE GWINN, MICHIGAN FACILITY**

Submitted to:

POTLATCH FOREST PRODUCTS CORPORATION

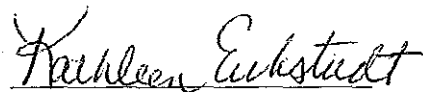
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Attention:

Lauren Lueneburg

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JUN 30 2014
AIR QUALITY DIV.

Reviewed by:



Kathleen Eickstadt
Coordinator
Source Testing Department

Report Number 14-33273(kilns)
June 19, 2014
SF/sef

ABBREVIATIONS

ACFM	actual cubic feet per minute
cc (ml)	cubic centimeter (milliliter)
DSCFM	dry standard cubic foot of dry gas per minute
DSML	dry standard milliliter
DEG-F (°F)	degrees Fahrenheit
DIA.	Diameter
FT/SEC	feet per second
g	gram
GPM	gallons per minute
GR/ACF	grains per actual cubic foot
GR/DSCF	grains per dry standard cubic foot
g/dscm	grams per dry standard meter
HP	horsepower
HRS	hours
IN.	inches
IN.HG.	inches of mercury
IN.WC.	inches of water
LB	pound
LB/DSCF	pounds per dry standard cubic foot
LB/HR	pounds per hour
LB/10 ⁶ BTU	pounds per million British Thermal Units heat input
LB/MMBTU	pounds per million British Thermal Units heat input
MW	megawatt
mg/dscm	milligrams per dry standard cubic meter
ug/dscm	micrograms per dry standard cubic meter
microns (um)	micrometer
MIN.	minutes
ng	nanograms
PM	particulate matter
PPH	pounds per hour
PPM	parts per million
ppmC	parts per million carbon
ppm,d	parts per million, dry
ppm,w	parts per million, wet
ppt	parts per trillion
PSI	pounds per square inch
SQ.FT.	square feet
TPD	tons per day
ug	micrograms
v/v	percent by volume
w/w	percent by weight

Standard conditions are defined as 68 °F (20 °C) and 29.92 IN. of mercury pressure

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1 INTRODUCTION

During the week of June 9, 2014 Interpoll Laboratories conducted air emission tests for the Potlatch Forest Products Corporation on the No. 4 Kiln at the Potlatch facility in Gwinn, Michigan. Kiln operation was supervised by Lauren Lueneburg of Potlatch. Testing was performed by Scott Fjelsta and James Thoma. The testing was witnessed by a Nathan Hude of the State of Michigan Department of Environmental Quality.

Potlatch Forest Products Corporation owns and operates four lumber kilns near Gwinn, Michigan. The purpose of these tests was to measure emissions for two species of wood: Red Pine and Jack Pine. These two species represent the majority of lumber dried at the Gwinn facility. Testing was conducted during two full kiln cycles, once while drying Red Pine, and once while drying Jack Pine. The kiln charges were selected from representative rough cut lumber for each species.

HAP concentrations (acetaldehyde, acrolein, formaldehyde, methanol, phenol and propionaldehyde) were determined in accordance with EPA Method 320. The on-line gas analysis was performed using an MKS MultiGas 2030 FTIR based analyzer. The MKS MultiGas 2030 FTIR has a fixed gas cell path length of 5.11 meters and is operated throughout the test with a scan rate of 64 scans per minute. The detector is cooled by using liquid nitrogen. The gas was transported to the FTIR analyzer through a heat traced Teflon line coming from a manifold system located within the test trailer. Prior to and following sampling the system was leak-checked and found to be acceptable. A dynamic spike was performed per the requirements of EPA Method 320, using a compressed gas cylinder containing a known amount of acetaldehyde (HAP) and sulfur hexafluoride. The results were found to be within acceptable tolerances. This data can be found in appendix I of this report. The Method 320 Run Data is contained in Appendix G.

NCASI 99.02 was used to confirm the presence or absence of the compounds to be identified in the Method 320 spectra. This is done by analyzing a collected NCASI samples on a GC/FID, MS and spectrophotometry that has been calibrated with the target VOC's. This method and its results aid in resolving spectra information collected with EPA Method 320.

Continuous velocity pressures were monitored at a representative point in the 42" diameter stack. In addition, continuous temperature was monitored using a type-K thermocouple attached to

the probe. Moisture content of the gas stream was also continuously measured and recorded using an MKS Multigas 2030 FTIR.

Total Volatile Organic Compounds (VOC's) were determined instrumentally using a VIG Industries heated flame ionization detector (HFID) calibrated against propane in air standards in accordance with EPA Method 25A. The VOC concentration was continuously monitored by extracting a slipstream of exhaust gas by means of a heated probe and filter holder set at a temperature of greater than 250°F. A heat-traced Teflon line set to maintain a temperature of greater than 325°F was used to transport the sample gas from the filter holder outlet to the analyzer inlet. The analog response of the analyzer was recorded using a computer data logger. The analyzer was calibrated with EPA Protocol I Gases.

A summary and discussion of all of the results of these tests is given in the following section. More detailed results of the various samplings are presented in Section 3, together with pertinent sampling parameters. Supplemental information such as field data sheets, laboratory results, procedures and calculation equations are presented in the appendices.

2 SUMMARY AND DISCUSSION

The results of the VOC determinations for each of the two kiln charges are summarized below:

Summary of the Results of the No. 4 Lumber Kiln Tests Performed for Potlatch Corporation at the Gwinn, Michigan Facility.

Parameter	Units	Red Pine	Jack Pine
Lumber Conditions			
Board Feet (per kiln Charge)	(mbf)	249.6	249.5
Charge Duration	(hrs)	20.2	9.92
Acetaldehyde Data			
	(lb/charge)	12.64	1.61
	(lb/mbf)	0.051	0.006
Propionaldehyde Data			
	(lb/charge)	4.54	1.37
	(lb/mbf)	0.018	0.005
Acrolein Data			
	(lb/charge)	3.62	0.83
	(lb/mbf)	0.014	0.003
Methanol Data			
	(lb/charge)	20.42	4.59
	(lb/mbf)	0.082	0.018
Phenol Data			
	(lb/charge)	5.56	2.04
	(lb/mbf)	0.022	0.008
Formaldehyde Data			
	(lb/charge)	1.13	0.54
	(lb/mbf)	0.005	0.002
VOC (EPA Method 25a)	(lb Carbon/mbf)	1.47	1.26

mbf = 1000 board feet

No difficulties were encountered in the field or in the laboratory evaluation of the samples. On the basis of these facts and a complete review of the data and results, it is our opinion that the concentrations and emission rates reported herein are accurate and closely reflect the actual values which existed at the time the tests were performed.

3 RESULTS

The results of individual EPA Method 320 determinations are presented in this section. There were a total of 9.92 hours sample time for the Jack Pine kiln charge, and 20.2 hours of sample time for the Red Pine kiln charge. The results of these test runs, and the continuous velocity, temperature and moisture readings were integrated into a continuous record for each kiln charge (Appendix G). The mass rate for total carbon was computed on a continuous basis, totaled and converted to units of lb/mbf. A copy of the test plan is included in the appendices which contains additional information on the facility.

The results have been calculated on a personal computer using programs written in Microsoft Excel specifically for source testing calculations. EPA-published equations have been used as the basis of the calculation techniques in these programs. Emission rates have been calculated using the product of the concentration times flow method.

3.1 Results of VOC/HAP Determinations (Red Pine)

Test 3 Summary of the Results of the June 10-11, 2014, Method 25a (as Carbon) & 320 Emission Compliance Test on the No.4 Kiln Stack while drying Red Pine at the Potlatch Facility located in Gwinn, Michigan.

Item		Red Pine Kiln Cycle	
Date of test		6/10/2014 to 6/11/2014	
Time runs were done	(Hrs)	1814 / 1419	
Kiln Charge Time	(Hrs)	20.2	
Volumetric Flow			
	Actual (ACFM)	13,659	
	Standard (DSCFM)	10,036	
Gas Temperature	(°F)	130	
Moisture Content	(%v/v)	14.75	
Gas Composition (%v/v, dry)			
	Carbon Dioxide	0.09	
	Oxygen	20.90	
	Nitrogen	79.01	
VOC	(EPA Method 25a)	Average (ppm C, d)	1,540.89
		Average (Lb Carbon/Hr)	18.16
		Total (Lb Carbon/Charge)	366.47
		Total (Lb Carbon/1000 Board Feet)	1.47
Total Board Feet in Kiln Charge		(mbf)	249,581

Acetaldehyde	Total (Lb /1000 Board Feet)	0.051
Acrolein	Total (Lb /1000 Board Feet)	0.014
Methanol	Total (Lb /1000 Board Feet)	0.082
Formaldehyde	Total (Lb /1000 Board Feet)	0.005
Propionaldehyde	Total (Lb /1000 Board Feet)	0.018
Phenol	Total (Lb /1000 Board Feet)	0.022

Test 3

Summary of the Results of the June 10 and 11, 2014, Method 320 (VOC/HAP's) Emission Compliance Test on the No.4 Kiln Stack while drying Red Pine at the Potlatch Facility located in Gwinn, Michigan.

Item			Run 1	Run 2	Run 3	Average
Date of test			6-10-14 to 6-11-14			
Time runs were done (Hrs)			1814 / 1419			
Volumetric Flow						
	Actual	(ACFM)	13,659			
	Standard	(DSCFM)	10,036			
Gas Temperature (°F)			130			
Moisture Content (%v/v)			15.89			
Gas Composition (%v/v, dry)						
	Carbon Dioxide		0.09			
	Oxygen		20.90			
	Nitrogen		79.01			
Acetaldehyde						
	Concentration	(ppm, d)	9.10			
	Emission Rate	(LB /HR)	0.63			
		(LB/Charge)	12.64			
		(LB/mbf)	0.051			
Acrolein						
	Concentration	(ppm, d)	2.05			
	Emission Rate	(LB /HR)	0.18			
		(LB/Charge)	3.62			
		(LB/mbf)	0.014			
Methanol						
	Concentration	(ppm, d)	20.23			
	Emission Rate	(LB /HR)	1.01			
		(LB/Charge)	20.42			
		(LB/mbf)	0.082			
Formaldehyde						
	Concentration	(ppm, d)	1.20			
	Emission Rate	(LB /HR)	0.056			
		(LB/Charge)	1.13			
		(LB/mbf)	0.005			
Propionaldehyde						
	Concentration	(ppm, d)	2.48			
	Emission Rate	(LB /HR)	0.225			
		(LB/Charge)	4.54			
		(LB/mbf)	0.018			
Phenol						
	Concentration	(ppm, d)	1.87			
	Emission Rate	(LB /HR)	0.28			
		(LB/Charge)	5.56			
		(LB/mbf)	0.022			

3.2 Results of VOC/HAP Determinations (Jack Pine)

Test 1 Summary of the Results of the June 10 , 2014, VOC by Methods 320 and 25a (as Carbon) Emission Compliance Test on the No.4 Kiln Stack while drying Jack Pine at the Potlatch Facility located in Gwinn, Michigan.

Item		Red Pine Kiln Cycle
Date of test		06-10-14
Time runs were done	(Hrs)	0730 / 1724
Kiln Charge Time	(Hrs)	9.92
Volumetric Flow		
Actual	(ACFM)	10,976
Standard	(DSCFM)	7,788
Gas Temperature	(°F)	131
Moisture Content	(%v/v)	15.14
Gas Composition		(%v/v, dry)
Carbon Dioxide		0.03
Oxygen		20.90
Nitrogen		79.07
VOC (EPA Method 25a)		
	Average (ppm C, d)	2,664.69
	Average (Lb Carbon/Hr)	31.63
	Total (Lb Carbon/Charge)	313.80
	Total (Lb Carbon/1000 Board Feet)	1.26
Total Board Feet in Kiln Charge	(mbf)	249.581
<u>HAPS</u>		
Methanol	Total (Lb /1000 Board Feet)	0.018
Acetaldehyde	Total (Lb /1000 Board Feet)	0.006
Acrolein	Total (Lb /1000 Board Feet)	0.003
Formaldehyde	Total (Lb /1000 Board Feet)	0.002
Propionaldehyde	Total (Lb /1000 Board Feet)	0.005
Phenol	Total (Lb /1000 Board Feet)	0.008

Test 1

Summary of the Results of the June 10, 2014, Method 320 (VOC/HAP's) Emission Compliance Test on the No.4 Kiln Stack while drying Jack Pine at the Potlatch Facility located in Gwinn, Michigan.

Item		Run 1	
Date of test		06-10-14	
Time runs were done		(Hrs)	0730 / 1724
Volumetric Flow			
	Actual	(ACFM)	10,976
	Standard	(DSCFM)	7,788
Gas Temperature		(°F)	131
Moisture Content		(%v/v)	15.14
Gas Composition			
	Carbon Dioxide		0.03
	Oxygen		20.90
	Nitrogen		79.07
Acetaldehyde			
	Concentration	(ppm, d)	3.01
	Emission Rate	(LB /HR)	0.16
		(LB/Charge)	1.61
		(LB/mbf)	0.006
Acrolein			
	Concentration	(ppm, d)	1.21
	Emission Rate	(LB /HR)	0.08
		(LB/Charge)	0.83
		(LB/mbf)	0.003
Methanol			
	Concentration	(ppm, d)	11.81
	Emission Rate	(LB /HR)	0.46
		(LB/Charge)	4.59
		(LB/mbf)	0.018
Formaldehyde			
	Concentration	(ppm, d)	1.48
	Emission Rate	(LB /HR)	0.054
		(LB/Charge)	0.54
		(LB/mbf)	0.002
Propionaldehyde			
	Concentration	(ppm, d)	1.94
	Emission Rate	(LB /HR)	0.138
		(LB/Charge)	1.37
		(LB/mbf)	0.005
Phenol			
	Concentration	(ppm, d)	1.78
	Emission Rate	(LB /HR)	0.21
		(LB/Charge)	2.04
		(LB/mbf)	0.008